MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

EEL3036 – POWER SYSTEMS ANALYSIS

(LE)

05 MARCH 2020
9.00 AM – 11.00 AM
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question Paper consists of 3 pages including the cover page with 4 Questions only.

2. Answer **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print your answers in the Answer Booklet provided.

Question 1

a) State THREE advantages of per unit calculations? [10 marks]

b) A single line diagram of a power system is shown in Figure 1. The ratings of various components and the reactance of the transmission line are also shown in the figure. Select a common base of 70 MVA, 220 kV in transmission line. Obtain the new per unit impedance values for all components in the figure. [15 Marks]

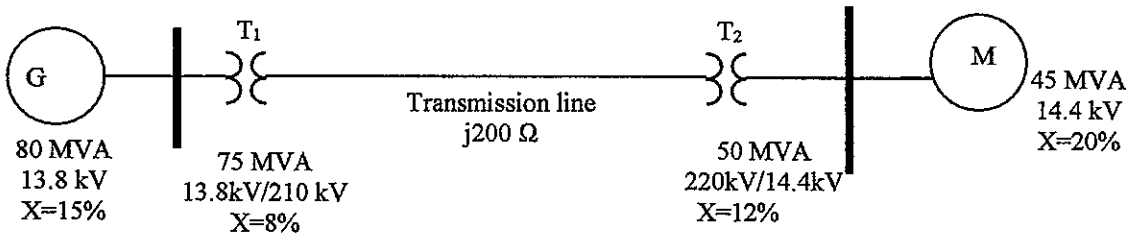

Figure 1

Question 2

The line data and bus data of a 4-bus power system are given in Table 2(a) and Table 2(b) respectively.

Table 2(a)

Serial No.	From Bus	To Bus	Admittance (p.u)
1	1	2	-j10
2	2	3	-j4
3	3	4	-j5
4	4	1	-j4
5	1	3	-j5

Table 2(b)

Bus No	Generation		Load		V, per unit	Remarks
	P, per unit	Q, per unit	P, per unit	Q, per unit		
1	-	-	0	0	$1.05\angle 0^0$	Slack Bus
2	0	0	2.5	1.0	$1.00\angle 0^0$	Load Bus
3	0	0	1.5	1.0	$1.00\angle 0^0$	Load Bus
4	0	0	0.5	-0.2	$1.00\angle 0^0$	Voltage-Controlled Bus

(a) Compute Y_{bus}. [6 Marks]

(b) Determine the voltage at bus 2 at the first iteration of the Gauss-Seidel method of power-flow analysis. [6 Marks]

(c) Form matrix $\overline{B}$ for use in the decoupled power flow method. [4 Marks]

Continued...

(d) Given that ΔQ_2 and ΔQ_3 values are -0.5 and -0.75 per unit respectively, calculate the voltage magnitudes at the end of first-iteration using the decoupled form of the Newton-Raphson method. [9 Marks]

Question 3

A 3-phase fault developed at point F of the system is shown in Figure 3. Choose an MVA_{base} of 125 MVA, evaluate the short-circuit current and the fault MVA. The lines have a reactance of 0.4 Ω/phase/km. Assume that all loads do not contribute to system fault level. [25 Marks]

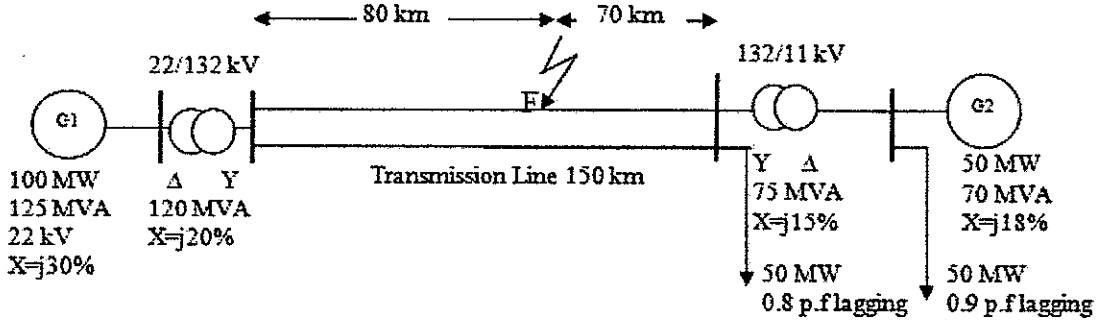

Figure 3

Question 4

(a) The system shown in Figure 4 delivers 1.0 p.u. and both the terminal voltage of the generator and the infinite bus is 1.0 p.u. The per unit reactances are marked in the figure. Calculate the power angle equation, and sketch the power angle curve for this problem. [15 Marks]

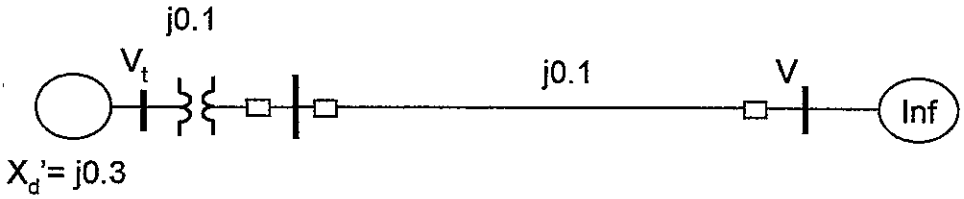

Figure 4

(b) A generator is supplying 1.0 per unit. of power to an infinite bus through a reactive network. A fault occurs and is cleared after some time. The power angle equations are:

Before the fault: $P_{max} \sin\delta = 2.0 \sin\delta$
During the fault: $r_1 P_{max} \sin\delta = 0.5 \sin\delta$
After the fault: $r_2 P_{max} \sin\delta = 1.0 \sin\delta$

Determine the critical clearing angle for the condition described.

(Hint: $\cos\delta_{cr} = \dfrac{(P_m / P_{max})(\delta_{max} - \delta_0) + r_2 \cos\delta_{max} - r_1 \cos\delta_0}{r_2 - r_1}$) [10 marks]

End of Paper